AOARD REPORT

Visit of the Korean Aerospace Research Institute (KARI)
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The Korean Aerospace Research Institute (KARI) was visited on 29 June 1994 to discuss the extent of aerospace research being carried out in the Republic of Korea. The major areas of research and development activity at KARI were found to be aircraft, aerospace, and satellite technologies. The institute was established in Oct 89 by the Korean Aerospace Industry Development Policy Commission to promote aerospace technology and create a competitive aerospace market in Korea. At present, the institute is in the process of building test facilities specifically for the purpose of testing aircraft and satellites. The first test facility scheduled for completion sometimes within this year is the subsonic wind tunnel facility. It seems that the institute will not have all the test facilities built in next two or three years for full scale test capabilities. The report discusses the extent of the current research and development activity being carried out at KARI.

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I. Introduction

To learn about newly established Korean research institutes working specifically on aerospace research, Dr Tom Davis and I visited the Korean Aerospace Research Institute (KARI), located in Daeduck Science Town, Taejon, for an hour between 1400 and 1500 on the 29th of June, 94. The visit was arranged by Mr F. Kenneth Crosher, science counselor of the US Embassy in Korea, before we departed Japan. The purpose of the visit was to meet key personnel at KARI and establish contacts in order to set up international collaborative programs between KARI and my office, the Asian Office of Aerospace Research and Development (AOARD). We were greeted by Dr Jai-Hak Hong, president of KARI; Dr Dong-Whan Choi, director of Aircraft R&D Division; and Dr Jeong-Joo Rhiu, director of Aerospace R&D Division. After the exchange of business cards as it is common in most of the oriental countries at the first meeting (Korea is no exception), Dr Davis and I presented the AOARD programs to KARI personnel for 15 minutes or so. Then it was followed by Dr Hong's short introductory talk about the history, role and mission, and major research activities of KARI. For the last 30 minutes of the visit, we moved the meeting to the main conference hall and saw a 10 minute video which explained the role and operation of KARI. After the video, Dr Choi and Dr Rhiu told us of their current research activities. The nature of the discussion is explained more in detail in this report.

Before we departed there, we were shown models of aircraft, sounding rockets and satellites which are displayed at their showcase hall, which is located at the entrance lobby of the KARI headquarters building.

Points of contact at KARI are shown below:

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II. History and Organization

On 10 Oct 89, KARI was created, along with the Korean Research Institute of Ships and Ocean Engineering (KRISCO), as part of the national development plan for establishing a strong technology basis for the Republic of Korea. Both research institutes were created as new subsidiaries to that of the existing Korean Institute of Machinery and Metals (KIMM), which was established in December, 1976. KARI was established as a leading Korean research institute to promote advanced aerospace research activities. KARI has a specific responsibility of advancing the level of Korean aerospace research to the world class and helping to create a very competitive aerospace market place in Korea.

At the present time, KARI is headed by Dr Jai-Hak Hong, the first person to be named as president of KARI. He is supported by five technical division chiefs who have responsibilities of managing aircraft R&D, aerospace R&D, satellite R&D, quality assurance, and technical support. Dr Choi and Dr Rhiu, who greeted us, are in charge of

Aircraft R&D Division and Aerospace R&D Division, respectively. As of today (in 94), KARI has a total workforce of 180 people with 120 people in four research divisions. Of 120 researchers, 56 are PhD holders.

As far as the budget is concerned, KARI's funding level has increased every year and is expected to increase in Fiscal Year 1995 due to the construction of about 20 test facilities which are scheduled for completion by 1995 according to Dr Hong. In the last four years, the actual budget figures were 4, 8, 11, and 35 million equivalent US dollars. The big increase from 11 to 35 million equivalent US dollars reflected the construction cost of the wind tunnel building which houses a subsonic wind tunnel facility designed to handle a maximum wind speed of 110 m/sec for flow dynamic testing. In the master construction plan, two more wind tunnel facilities and one satellite assembly testing building are scheduled to be built by 1995; however, they are waiting for government approvals.

III. Research and Development Activity

Aircraft, aerospace, and satellite technologies are main focus areas of KARI's R&D activities. The research areas in aircraft technology include aerodynamic, structural mechanics, aeropropulsion, flight dynamics and control, and aircraft system. In aerospace technology, space launcher, space propulsion system, satellite bus, and space test are research areas being investigated at KARI. In satellite technology, KARI is performing mission analysis and developing core parts of a satellite system, such as electrical power, telemetry, and command/control subsystems, as well as setting up ground tracking and control stations.

III-1. Aircraft Technology

The thrust of aerodynamic research is to perform theoretical and computational flow analysis and compare the results with wind tunnel experimental data. Currently, researchers are in the process of coming up with plans for subsonic wind tunnel experiments. They are waiting for completion of the mid-class subsonic wind tunnel facility scheduled for operation sometimes within this year. They use a 1/40 scale model of a mid-class commuter airplane specifically designed to study the effect of the wakefield flow pattern. The aim of their experiment is to come up with an efficient fluid-dynamic computational technique so that they can use it to design a low drag airfoil.

In structural mechanics, researchers are using the Aero 90' Aircraft Structural Test machine for testing kinematics and structural properties of aircraft. It is capable of handling a weight of up to 20 tons for compression tests. The other type of testing performed is the non-destructive ultrasound test which is used to make indirect measurements of the damage of specific aircraft components. For detailed analysis of structural failure modes, researchers are developing computer codes, which make use of the finite element technique.

In the aeropulposion area, KARI is aiming to establish in-house technologies needed to develop gas turbine engines. An extensive amount of efforts is invested in coming up with computer simulation models to predict detailed flow patterns. For testing, the laboratory is equipped with a 3-D laser Doppler velocimetery, a turbine blade cascade wind tunnel test set up, a 100 lb_f thrust gas turbine engine, and a spin & burst rotating test machine.

In the area of flight dynamics and control, researchers are using R & D flight simulator and unmanned airship to test various designs of auto-pilot systems equipped with robust

flight control mechanisms. The unmanned airship was built last year for the 93' Expo held in Taejon to demonstrate their accomplishments in flight dynamics and control research areas.

III-2. Aerospace Technology

The Aerospace R&D division carries out research on development and operations of sounding rockets and development and integration of satellites and its related technologies. Active research efforts are focused in Korean government national projects involving the development of the KOREASAT satellite and its launcher system as well as performing structural, thermal control, and environmental tests for the KITSAT satellite.

The sounding rocket was built in 1993 to reach an altitude of 70-75 km with a payload capacity of 150 kg, of which 50 kg is allocated specifically for the scientific purpose. The length and weight of the rocket are 6.7 meters and 1.3 tons, respectively. It is used to take data at ozone and ionosphere layers over the Korean Peninsula.

In the area of space propulsion research, KARI is responsible for the development of solid and liquid apogee kick motors for placing a satellite in geostationary orbit and providing the sufficient thrust for orbit control. For the sounding rocket, the thrust of solid rocket motors can handle a weight of 10 tons for liftoff.

In the area of developing Korean satellites, KARI is placing a great deal of efforts in the design of the satellite bus system. They are placing special care for designs of structure and attitude control subsystems in order to assure the proper operation of the satellite in the space environment. For testing, the Space Test group is formed specifically to conduct integration, assembly, and environmental tests of satellites for independent checks. Some of the major test equipment used for space quality testing consist of the thermal vacuum test chamber, the satellite vibration test device, and the satellite physical properties measurement device. Also, the Assembly, Integration, and Test Center will be available in the future to conduct development and qualification tests on future scientific and communication satellites.

III.3 Quality Assurance

To ensure the safety and reliability of products coming out of KARI, KARI is developing the quality evaluation procedures and establishing the different types of certification.

As delegated under the Aeronautics and Space Industry Development Promotion Act of the Republic of Korea, KARI is the authorized inspection agency, responsible for issuing the Production Certificate for the performance and quality inspection of aircraft, spacecraft, launchers and its related products in Korea. Another certificate, as delegated under the Aviation Act, is the Type and Airworthiness Certificate.

The technical support to the industry is provided by the quality assurance group. The support includes international cooperation, test and evaluation and education and training. Following are names of international organizations having signed the Memorandum of Understanding with KARI as of 1993.

USA: - McDonnell Douglas Co.
- General Dynamic Co.

Russia: - Central Aerohydrodynamic Institute
- Central Institute of Aviation Motors

	- GLAVKOSMOS Co.
France:	- Centre National D'studes Spatiales
	- Arianspace Co.
England:	- British Aerospace Co.
Israel:	- Israel Aerospace Industry
China:	- Nanjing Aeronautical Institute

IV. Summary

At present, the Korean aerospace industry is far behind that of the US and it takes at least a decade or more to catch up to the level of the current US aerospace technology.

It has been only four years that Korea has taken an active role in establishing the strong aerospace market by creating the Korean Aerospace Research Institute. KARI has done a good job in last four years just to initiate the whole process of setting up the foundation for the future of the Korean aerospace market. I would expect they need two or three more years before they could complete the whole process.

To show the progress of establishing the Korean aerospace industry, KARI has exhibited a sounding rocket and the UFO type unmanned airship during the EXPO '93, held in Taejon last year. At present, KARI is participating in KOREASAT and KITSAT projects to develop essential aerospace technologies needed to catch up the US and Japan in order to join the satellite communications community. In the near future, I would expect KARI's aircraft technology to advance at much faster rate once the subsonic wind tunnel facility becomes fully operational this year.